

**OROVILLE FERC RELICENSING
(PROJECT No. 2100)**

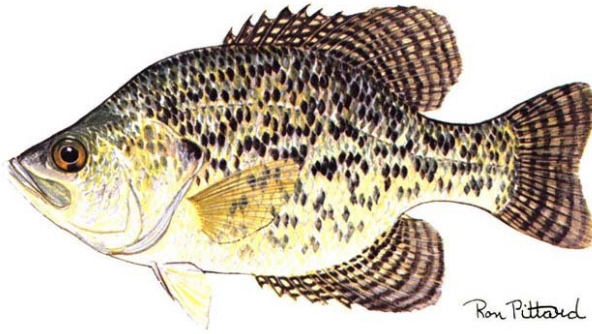
**INTERIM REPORT
SP-F3.2 TASK 2
SP-F21 TASK 1**

**APPENDIX A
MATRIX OF LIFE HISTORY AND HABITAT REQUIREMENTS FOR
FEATHER RIVER FISH SPECIES**

**LITERATURE REVIEW OF LIFE HISTORY AND
HABITAT REQUIREMENTS FOR
FEATHER RIVER FISH SPECIES**

WHITE CRAPPIE

JANUARY 2003

Element	Element Descriptor	General	Feather River Specific
General			
common name (s)	English name (usually used by fishers and laypeople).	White Crappie	
scientific name (s)	Latin name (referenced in scientific publications).	<i>Pomoxis annularis</i>	
taxonomy (family)	Common name of the family to which they belong. Also indicate scientific family name.	Sunfishes - <i>Centrarchidae</i>	
depiction	Illustration, drawing or photograph.	 <p>© Windsor Nature Discovery</p>	
range	Broad geographic distribution, specifying California distribution, as available.	<p>The native range of the white crappie extends from the Mississippi River drainage to the Gulf Coast, along the eastern seaboard to North Carolina, and northward to most of the Great Lakes basin (Wang 1986).</p> <p>White crappie were originally distributed throughout the Mississippi River basin north into Minnesota, east through the Great Lakes basin, and west and south to the Rio Grand River and Gulf Coast drainages of northern Mexico. They have been introduced successfully into reservoirs and lakes throughout the United States and Mexico (Moyle 2002).</p>	
native or introduced	If introduced, indicate timing, location, and methods.	White crappie are native (Wang 1986).	

Element	Element Descriptor	General	Feather River Specific
ESA listing status	Following the categories according to California Code of Regulations and the Federal Register, indicate whether: SE = State-listed Endangered; ST =State-listed Threatened; FE = Federally listed Endangered; FT = Federally-listed Threatened; SCE = State Candidate (Endangered); SCT = State candidate (Threatened); FPE = Federally proposed (Endangered); FPT = Federally proposed (Threatened); FPD = Federally proposed (Delisting); the date of listing; or N = not listed.	White crappie are not listed.	
species status	If native, whether: Extinct/extirpated; Threatened or Endangered; Special concern; Watch list; Stable or increasing. If introduced, whether: Extirpated (failed introduction); highly localized; Localized; Widespread and stable; Widespread and expanding.	White crappie are a freshwater species and their status is “widespread and stable” (Moyle 2002).	
economic or recreational value	Indicate whether target species sought for food or trophy. Whether desirable by recreational fishers, commercial fishers, or both.	White crappie are a highly favored game fish (Moyle 2002).	
warmwater or coldwater	Warmwater if suitable temperature range is similar to basses; coldwater if suitable temperature range is similar to salmonids.	White crappie are a warmwater fish (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
pelagic or littoral	Environment: Pelagic - living far from shore; Littoral - living near the shore.	White crappie are littoral and are most abundant in warm, turbid lakes, reservoirs, and river backwaters (Moyle 2002).	
bottom or water column distribution	Environment: bottom (benthic) or along water column.	White crappie are found throughout the water column.	
lentic or lotic	Environment: Lentic - pertaining to stagnant water, or lake-like; Lotic - moving water, or river-like.	White crappie are both lentic and lotic and are found in streams and reservoirs (Moyle 2002).	

Adults

life span	Approximate maximum age obtained.	The maximum life expectancy of white crappie has been reported as 8 to 10 years, but few live more than 3 to 4 years (Wang 1986). In California, white crappie seldom live longer than 7 to 8 years (Moyle 2002).	
adult length	Indicate: Length at which they first reproduce; average length and maximum length the fish can attain.	White crappie become mature in their second or third year at 3.9 to 7.9 inches (10 to 20 centimeters) in length. They seldom grow larger than 13.8 inches (35 centimeters) in length (Moyle 2002).	
adult weight	Indicate: Weight at which they first reproduce; average weight and maximum weight the fish can attain.	The maximum weight of white crappie is 1.8 pounds (0.8 kilograms) [at 13.8 inches (35 centimeters) in length] (Moyle 2002).	
physical morphology	General shape of the fish: elongated, fusiform, laterally compressed, etc.	White crappie have deep, laterally compressed bodies (Moyle 2002).	

coloration	Indicate color, and color changes, if any, during reproduction phase.	Adult white crappie are iridescent olive green on their backs and silvery-white on their sides, usually with 10 or fewer indistinct, dark vertical bars (Moyle 2002).	
other physical adult descriptors	Unique physical features for easy identification.	Dorsal, anal, and caudal fins on white crappie are checkered with dark spots. Breeding males become very dark, the head and breasts turning nearly completely black (Moyle	

Element	Element Descriptor	General	Feather River Specific
		2002).	
adult food base	Indicate primary diet components.	<p>The diet of white crappie is typically a mixture of planktonic crustaceans and small fish (Moyle 2002).</p> <p>Fish and large invertebrates usually predominate in the diet of individual white crappie larger than 5.5 inches (140 millimeters) in length (Moyle 2002).</p>	
adult feeding habits	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder.	<p>The basic feeding strategy of white crappie is to swim a short distance, halt, scan for prey, and then capture whatever is close by (Moyle 2002).</p> <p>White crappie move into open water to feed during the evening and early morning (Moyle 2002).</p>	
adult in-ocean residence time	For anadromous species, age when they migrate to the ocean and duration spent in the ocean before returning to freshwater to spawn.	N/A	
adult habitat characteristics in-ocean	For anadromous species, description of the ocean habitat utilized: whether along major current systems, gyres, pelagic (beyond continental shelves) and neritic (above continental shelves) zones, etc.	N/A	
Adult upstream migration (immigration)			
range of adult upstream migration timing	Time of year adults migrate upstream. If applicable, indicate for various runs.	N/A	
peak adult upstream migration timing	Time of year most adults migrate upstream. If applicable, indicate for various runs.	N/A	

Element	Element Descriptor	General	Feather River Specific
adult upstream migration water temperature tolerance	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	N/A	
adult upstream migration water temperature preference	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.	N/A	
Adult holding (freshwater residence)			
water temperature tolerance for holding adults	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Water temperatures greater than 87.8°F (31°C) are usually stressful to white crappie, and those above 98.6°F to 100.4°F (37°C to 38°C) are usually lethal (Moyle 2002).	
water temperature preference for holding adults	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental.	Reported optimal water temperatures for adult white crappie appear to be around 80.6°F to 84.2°F (27°C to 29°C) (Moyle 2002).	
water depth range for holding adults	Reported range of observed (minimum and maximum) water depth utilization.	Data for white crappie habitat (where fish were found) was collected at a range of 0 to 19.7 feet (0 to 6 meters) deep within a Kentucky reservoir (Hale 1999).	
water depth preference for holding adults	Reported range of most frequently observed water depth utilization.	<p>Data was most often collected at 9.8 feet (3 meters) when white crappie were sampled (Hale 1999).</p> <p>Previous studies have documented uninhabitable DO levels for white crappie below 9.8 feet (3 meters) during the summer months (Hale 1999).</p> <p>During the day, white crappie tend to congregate around submerged logs or boulders in quiet water 6.6 to 13.1 feet (2-4 meters) deep (Moyle 2002).</p>	
substrate preference for holding adults	If bottom dwellers, indicate substrate: mud, sand, gravel, boulders, aquatic plant beds, etc. If gravel, indicate range or average size of gravel.	During the day, white crappie tend to congregate around submerged logs or boulders in quiet water (Moyle 2002).	

Element	Element Descriptor	General	Feather River Specific
water velocity range for holding adults	Reported range of observed (minimum and maximum) water velocity utilization.		
water velocity preference for holding adults	Reported range of most frequently observed water velocity utilization.	White crappie prefer low velocity areas, including pools and backwaters, as observed in a variety of water bodies in Canada (Biota Information System of New Mexico 2001).	
other habitat characteristics for holding adults	General description of habitat (e.g. turbid or clear waters, lentic or lotic, presence of aquatic plant beds, debris, cover, etc.).	White crappie are most abundant in warm, turbid lakes, reservoirs, and river backwaters (Moyle 2002). White crappie appear to have a high tolerance for high turbidity (Moyle 2002).	
timing range for adult holding	Time of year (earliest-latest) and duration of stay from upstream migration to spawning.		
timing peak for adult holding	Time of year when maximum number of adults are present before spawning.		
Spawning			
fecundity	Average or range in the number of eggs females lay in a spawning season.	Fecundity of white crappie is highly variable, and the number of eggs (970 to 326,000) is only partially related to size (Moyle 2002). Female white crappie release only a few eggs at each interval and mate with different males (Wang 1986).	
nest construction	Location and general description of nest -- substrates, aquatic plants, excavations, crevices, habitat types, etc.	Male white crappie construct nests in colonies underneath or close to overhanging bushes or banks in water less than 3.3 feet (1 meter) deep. Nests are occasionally built in water as deep as 19.7 to 23 feet (6 to 7 meters). Nests usually consist of shallow depressions in hard clay bottoms (rarely in sand or gravel) near or in beds of aquatic plants, algae, or submerged plant debris (Moyle 2002). White crappie nests are constructed by males in shallow water, usually less than 3.3 feet (1 meter) in depth, but sometimes up to 9.8 feet (3 meters) or even deeper [19.7 to 23 feet (6 to 7 meters)]. Nests are constructed on hard bottoms using gravel, clay, and plant materials; sometimes the nests lack depressions (Wang 1986).	

Element	Element Descriptor	General	Feather River Specific
nest size	Size and average dimensions of the nest.	Under laboratory conditions, white crappie nest size varied and was sometimes difficult to measure due to the type of substrate used and the ill-defined borders. Average white crappie nest diameter was approximately 11.8 inches (30 centimeters) (Siefert 1968).	
spawning process	Indicate whether nest builder, broadcast spawner, or other.	During spawning, while crappie move slowly upward and forward with their bodies quivering and the female slides under the male and pushes him up and to the side to move the pair into a curve as the eggs and sperm are emitted, as observed under laboratory conditions (Siefert 1968).	
spawning substrate size/characteristics	Range of substrates used during spawning (e.g. mud, sand, gravel, boulders, beds of aquatic plants). Indicate presence of plant/wood debris, crevices at spawning sites. If gravel, indicate range of average size.	No substrate preference for white crappie nesting was evident (Siefert 1968).	
preferred spawning substrate	Indicate preferred spawning substrate (e.g., mud, sand, gravel, boulders, plant bed, etc).	Under laboratory conditions, white crappie selected areas with some protected object or bottom vegetation (Siefert 1968).	
water temperature tolerance for spawning	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	The water temperature range in which white crappie spawn is 62.6°F to 68°F (17°C to 20°C) (Moyle 2002). Under laboratory conditions, the spawning temperature for white crappie ranged from 57.2°F to 73.4°F (14°C to 23°C) (Siefert 1968).	
water temperature preference for spawning	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.	Most white crappie spawning took place at 60.8°F to 68°F (16°C to 20°C) under laboratory conditions (Siefert 1968).	
water velocity range for spawning	Minimum and maximum speed of water current the spawning fish can tolerate.		

Element	Element Descriptor	General	Feather River Specific
water velocity preference for spawning	Preferred water current (flow velocity) during spawning.	Low water velocities are essential for white crappie breeding adults to ensure egg survival, as determined through a literature review of previous completed studies (Biota Information System of New Mexico 2001).	
water depth range for spawning	Reported range of observed (minimum and maximum) water depth utilization.	Spawning depths for white crappie range from 3.2 to 23 feet (1 to 7 meters) (Moyle 2002).	
water depth preference for spawning	Reported range of most frequently observed water depth utilization.	The optimal water depth for white crappie spawning is usually less than 3.2 feet (1 meter) (Moyle 2002).	
range for spawning timing	Earliest and latest time of season or year in which spawning occurs.	The white crappie spawning season ranges from April through June (Wang 1986).	
peak spawning timing	Time of year most fish start to spawn.	White crappie spawning begins most often in April or May (Moyle 2002).	
spawning frequency (iteroparous/semelparous)	Semelparous - producing all offspring at one time, such as in most salmon. Usually these fish die after reproduction. Iteroparous - producing offspring in successive, e.g., annual or seasonal batches, as is the case in most fishes.	White crappie are iteroparous.	
Incubation/early development			
egg characteristics	Shape, size, color, in clusters or individuals, stickiness, and other physical attributes.	White crappie eggs are spherical in shape, range from 0.03 to 0.04 inches (0.82 to 0.92 millimeters) in diameter, have a colorless yolk, and are adhesive. The egg mass is single to small clumps (Wang 1986).	
water temperature tolerance for incubation	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	The water temperature extremes in which white crappie eggs can survive ranges from 57.9°F to 73°F (14.4°C to 22.8°C) (Siefert 1968).	
water temperature preference for incubation	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.	The optimum temperature range for white crappie incubation is 66°F to 67°F (18.9°C to 19.4°C) (Siefert 1968).	

Element	Element Descriptor	General	Feather River Specific
time required for incubation	Time duration from fertilization to hatching. Note: Indicate at which temperature range. Incubation time is temperature-dependent.	<p>White crappie hatching occurs within 43 to 103 hours (Siefert 1968).</p> <p>White crappie incubation lasts 43 to 51 hours at 57.2°F to 64.9°F (14.0°C to 18.3°C) and 93 hours at 57.9°F (14.4°C) (Wang 1986).</p> <p>At water temperatures of 57.9°F (14.4°C), eggs began hatching in 93 hours; between 64.9°F and 66.9°F (18.3°C to 19.4°C) eggs hatched in 43 to 51 hours; and at 73.0°F (22.8°C) eggs hatched in 42 hours (Siefert 1968).</p>	
size of newly hatched larvae	Average size of newly hatched larvae.	The average size of the newly hatched white crappie larvae ranges from 0.05 to 0.08 inches (1.22 to 1.98 millimeters) in length (Wang 1986).	
time newly hatched larvae remain in gravel	Time of year of hatching, and duration between hatching and emergence from gravel.	The average time between the start of white crappie hatching and departure of all nest brood members was 95 hours (ranging from 51 to 162 hours) (Siefert 1968).	
other characteristics of larvae	Alevin -- early life history phase just after hatching (larva) when yolk-sac still present.	<p>Newly hatched white crappie larvae are transparent (Wang 1986).</p> <p>White crappie absorbed the yolk sac at lengths from 0.17 to 0.18 inches (4.5 to 4.6 millimeters) (Siefert 1968).</p>	
timing range for emergence	Time of year (earliest-latest) hatchlings (larvae and alevins) leave or emerge from the nesting/hatching (gravel) sites.		
timing peak for emergence	Time of year most hatchlings emerge.		
size at emergence from gravel	Average size of hatchlings at time of emergence.	Size of the white crappie larvae leaving the nest ranged from 0.16 to 0.18 inch (4.1 to 4.6 millimeters) (Siefert 1968).	
Juvenile rearing			
general rearing habitat and strategies	General description of freshwater environment and rearing behavior.		

Element	Element Descriptor	General	Feather River Specific
water temperature tolerance for juvenile rearing	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	Water temperatures frequently ranged from 78.8°F to 82.4°F (26°C to 28°C) within the North Fork of the Rough River Lake where juvenile white crappie were present (Hale 1999).	
water temperature preference for juvenile rearing	Range of suitable, preferred, or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.	Water temperatures preferred for rearing juveniles ranged from 70°F to 81°F (21°C to 27°C), as determined through a literature review of previous completed studies (Biota Information System of New Mexico 2001).	
water velocity ranges for rearing juveniles	Reported range of observed (minimum and maximum) water velocity utilization.		
water velocities preferred by rearing juveniles	Reported range of most frequently observed water velocity utilization.	Although white crappie tolerate moderate turbidity, best growth occurs in clearer waters as observed within ponds in Douglas County, Kansas (Biota Information System of New Mexico 2001).	
water depth range for juvenile rearing	Reported range of observed (minimum and maximum) water depth utilization.		
water depth preference for juvenile rearing	Reported range of most frequently observed water depth utilization.		
cover preferences for rearing juveniles	Type of cover for protection from predators used by rearing juveniles (e.g., crevices, submerged aquatic vegetation, overhanging vegetation, substrate cover, undercover bank, small woody debris, large woody debris).	Juvenile white crappie school in ponds and reservoirs near weedy shores (Wang 1986).	

Element	Element Descriptor	General	Feather River Specific
food base of juveniles	Indicate primary diet components. Also indicate the diet changes, if any, as growth occurs.	The major dietary component of small juvenile white crappie is planktonic crustaceans; larger juveniles feed on insects and small fishes such as threadfin shad and inland silverside (Wang 1986). Zooplankton is the main food of white crappie measuring less than 5.5 inches (140 millimeters) in length (Moyle 2002).	
feeding habits of rearing juveniles	Indicate whether plankton eater, algae eater, bottom feeder, piscivorous, active hunter, ambush predator, filter feeder. Night, day, dusk or dawn feeder. Also indicate change of feeding habits growth occurs.	Young-of-the-year white crappie feed mostly during the day, with a peak feeding occurring in mid-afternoon (Moyle 2002).	
predation of juveniles	Indicate which species prey on juveniles.	Newly hatched and young-of-the-year white crappie are common prey for yellow perch, walleyes, largemouth bass, and northern pike. Older crappie are preyed upon mainly by largemouth bass, northern pike, and muskies. Predatory birds, otters, and minks also occasionally eat white crappie (Paulson et al. 2002).	
timing range for juvenile rearing	Range of time of year (months) during which rearing occurs.	The primary growth period for white crappie was April through October, as observed within the North Fork of the Rough River Lake (Hale 1999).	
timing peak for juvenile rearing	Time of year (months) during which most rearing occurs.	There is a three month period (July through September) when young-of-the-year white crappie are considered to have successfully recruited into the population, as observed within Elk City Reservoir (Beam 1983).	
Juvenile emigration			
time spent in fresh water prior to emigrating	Duration (in years and/or months) from emergence to emigration to the ocean.	N/A	
water temperature tolerances during emigration	Range of water temperatures allowing survival. Indicate stressful or lethal levels.	N/A	

Element	Element Descriptor	General	Feather River Specific
water temperature preferences during emigration	Range of suitable, preferred or reported optimal water temperatures. Indicate whether literature, observational, or experimental derivation.	N/A	
emigration timing range	Time of year juveniles commence emigration and duration of emigration.	N/A	
emigration timing peak	Time of year most juveniles are emigrating.	N/A	
size range of juveniles during emigration	Minimum and maximum sizes (inches or mm) of emigrating juveniles. Indicate average size.	N/A	
factors associated with emigration	Pulse flows, water temperature changes, turbidity levels, photoperiod, etc.		
Other potential factors			
DO	Levels of dissolved oxygen in water expressed in mg/l tolerated by fish.	White crappies are unlikely to frequent areas with a DO lower than 3.0 mg/L (Hale 1999). White crappie tolerate moderate DO (5 to 7 mg/L), as determined through a literature review of previous studies (Biota Information System of New Mexico 2001).	
pH	Alkalinity/acidity of water (expressed in pH) that fish can tolerate.	White crappie appear to have high tolerances for alkaline water (Moyle 2002).	
turbidity	Indicate turbidity or state of water (e.g., clear water or presence of siltation or organic/inorganic matter in water) that fish can tolerate.	White crappie appear to have high tolerances for high turbidity, high water velocity, high water temperatures, and a lack of aquatic vegetation and cover (Moyle 2002).	
factors contributing to mortality	e.g., fishing/angling mortality, drastic habitat alterations, unfavorable climatic changes, etc.	Introduction of the Mississippi silverside into Clear Lake (Lake County) has altered the growth patterns of the white crappie, causing a reduction in the growth during the first two years of life (Li et al. 1976).	

Element	Element Descriptor	General	Feather River Specific
		The growth rates of juvenile (age-1) and adult (age-2) white crappie decreased during the summer in a thermally stratified Kentucky reservoir (Hale 1999).	

References

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